Lake Water Clarity Assessment at Broad Geographic Scales Using Satellite Remote Sensing

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Biographical Sketch of the Authors
Steve Kloiber is a Senior Water Resource Planner with the Metropolitan Council of the Twin Cities Metropolitan Area (Minneapolis and St. Paul, MN) and is involved with GIS-based watershed modeling of NPS pollutant loading as well as the development of an environmental data warehouse. Dr. Kloiber recently completed his Ph.D. in civil/environmental engineering at the University of Minnesota in March, 2002. His dissertation is on the use satellite remote sensing and GIS for regional assessment of lakes. Pat Brezonik is a professor in the civil engineering department and the Director for the Water Resource Center at the University of Minnesota. Marv Bauer is a professor in the department of forest resources and is the Director for the Remote Sensing Laboratory at the University of Minnesota. Leif Olmanson is a scientist at the Remote Sensing Laboratory. The authors have been involved with several research projects dealing with the development and application of regional-scale, lake water clarity assessment techniques using satellite imagery.

Abstract
Minnesota is fortunate to have a large number of lakes, but managing these lakes poses a significant challenge. Effective lake management requires long-term water quality information on a broad regional scale. However, the expense and time requirements of ground-based monitoring make it effectively impossible to adequately monitor more than a small fraction of this resource by conventional field methods. The use of satellite remote sensing is a potentially cost-effective way to develop comprehensive regional databases that can be used to evaluate regional differences and water quality trends over time. Coupled with land-use data, this information may also provide insight on land-use impacts on lakes.

This paper summarizes our work on the development of regional-scale, lake water clarity assessment techniques using satellite imagery, including Landsat, IKONOS, and MODIS data. Initially, this work focused on the Twin Cities (Minneapolis and St. Paul) Metropolitan Area (TCMA). A procedure was developed to estimate water clarity using satellite imagery and trends were evaluated for more than 500 lakes over a period 25-year period. These data were also used to assess spatial patterns and investigate the relationship between water clarity and landscape variables. In addition, this procedure has been used to study the impacts of land development on water clarity for over 300 lakes in West-Central Minnesota. Recently, this procedure has been modified so that it can be applied to statewide lake water clarity assessments. Issues encountered in expanding the procedure to this geographic scale will be discussed.